

WHAT IS CLAIMED IS:

1. A thickener/clarifier, comprising:

(a) a vessel having an inlet for receiving a slurry of a liquid and solid particles suspended in the liquid, said vessel having an upper portion holding a free settling zone having a relatively low concentration of solid slurry particles and having a lower portion holding a compaction zone having a relatively high concentration of solid slurry particles and a hindered settling zone between said compaction zone and said free settling zone, with said compaction zone and said hindered settling zone constituting lower settling zones;

(b) an overflow launder adjacent said upper end of said vessel for discharge of an overflow phase of the slurry that has been separated in said vessel;

(c) an underflow discharge port adjacent said bottom of said vessel for discharge of a thickened, underflow phase of the slurry that has been separated in said vessel;

(d) a deliquifying member in said vessel extending up from said lower portion of said vessel to said upper portion of said vessel for flow of liquid from at least one of said lower settling zones to said free settling zone while isolating said flow of liquid from the flow of slurry down in said lower settling zones; and

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(e) a rake assembly mounted for rotation in said lower portion of said vessel, with said rake assembly having at least one elongated generally vertical picket forming channels in the slurry held in said lower portion of said vessel for releasing liquid in at least one of said lower settling zones to flow to said deliquifying member and on to said free settling zone.

5 2. The thickener/clarifier of claim 1 wherein said rake assembly further

10 includes a rotary drive for rotation of said rake assembly about a generally vertical axis.

15 3. The thickener/clarifier of claim 2 wherein said rotary drive is disposed at the upper end of said vessel, said rotary drive being connected to said rake assembly via an elongate drive member extending vertically down into said vessel.

4. The thickener/clarifier of claim 3 wherein said drive member is of tubular configuration for at least a portion of its length to receive

20 liquid released from a lower settling zone.

5. The thickener/clarifier of claim 3 wherein said drive member is received in a tubular member surrounding said shaft, said tubular member receiving liquid released from a lower settling zone.

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6. The thickener/clarifier of claim 1 wherein said rake assembly includes a plurality of pickets extending generally parallel to one another.
7. The thickener/clarifier of claim 6 wherein said pickets extend into the compaction zone.
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8. The thickener/clarifier of claim 7 wherein said pickets extend into both said compaction zone and said hindered settling zone.
9. The thickener/clarifier of claim 1 wherein said deliquifying member is open adjacent its lower end to receive liquid from at least one of said lower settling zones and is open adjacent its upper end to discharge liquid conveyed by said deliquifying member to said free settling zone.
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10. The thickener/clarifier of claim 9 wherein said deliquifying member is open to receive liquid for a substantial portion of its length.
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11. The thickener/clarifier of claim 9 wherein said deliquifying member is a tube with fluid flow openings therein.
12. The thickener/clarifier of claim 9 wherein said deliquifying member further comprises an inclined member extending over the opening in said deliquifying member adjacent its lower end.
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13. The thickener/clarifier of claim 11 wherein said deliquifying member has openings at spaced locations along its length.
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14. The thickener/clarifier of claim 13 wherein said deliquifying member has

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inclined members extending over said openings in said
deliquifying
member in said lower portion of said vessel.

15. The thickener/clarifier of claim 12 wherein said inclined
member
comprises a conical baffle.

16. The thickener/clarifier of claim 7 wherein said deliquifying
member is open adjacent its lower end to receive liquid from
at least one of said lower settling zones and said at least one
of said picket extends below said opening adjacent a lower
end of said deliquifying member.

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17. The thickener/clarifier of claim 7 wherein said at least one of said
picket is
positioned with its upper end below a lower end of said
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deliquifying
member.

18. A method of operating a thickener/clarifier having an upper
portion and a
lower portion, comprising:
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(a) feeding a slurry of a liquid and solid particles
suspended in the liquid into a vessel;
(b) separating said slurry by gravity into different zones
having respective degrees of liquid-solids separation
including, at an upper portion of said vessel, a free
settling zone having a relatively low concentration of
solid slurry particles and further including, at a lower
portion of said vessel, a compaction zone having a
relatively high concentration of solid slurry particles

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and a hindered settling zone between said free settling zone and said compaction zone, with said hindered zone and said compaction zone constituting lower settling zones;

5 (c) discharging an overflow phase of the slurry that has been separated in said vessel into an overflow launder adjacent to an upper end of said vessel;

(d) discharging, via an underflow discharge adjacent a bottom of said vessel, a thickened, underflow phase of the slurry that has been separated in said vessel;

10 (e) directing liquid from at least one of said lower settling zones to flow up to said free settling zone via a flow path isolated from the flow of the slurry down in said vessel in said lower settling zones; and

15 (f) forming generally upwardly extending channels in the slurry held in said lower portion of said vessel to release liquid in at least one of said lower settling zones to flow to said isolated flow path and then on to said free settling zone.

20 19. The method of claim 18 further comprising moving a rake assembly in said lower portion of said vessel.

20. The method of claim 19 wherein said rake assembly is rotated about a generally vertical axis.

21. A thickener/clarifier, comprising:

25 (a) a vessel having an inlet for receiving a slurry of a liquid and solid particles suspended in the liquid, said vessel having an upper portion surrounding a free settling zone having a relatively low concentration of

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solid slurry particles and having a lower portion surrounding a compaction zone having a relatively high concentration of solid slurry particles, and a hindered settling zone between said compaction zone and said free settling zone, with said compaction zone and said hindered settling zone constituting lower settling zones;

5 (b) an overflow launder adjacent said upper end of said vessel for discharge of an overflow phase of the slurry that has been separated in said vessel;

10 (c) an underflow discharge port adjacent said bottom of the vessel for discharge of a thickened, underflow phase of the slurry that has been separated in said vessel;

15 (d) a deliquifying member in said vessel extending up from said lower portion of said vessel to said upper portion of said vessel for flow of liquid to said free settling zone from at least one of said lower settling zones while isolating said flow of liquid from the flow of slurry down in said lower settling zones; and

20 (e) an injector for injecting flocculant into the flow of water to said free settling zone to facilitate settling of solid particles in the water.

22. The thickener/clarifier of claim 21 wherein the injector extends into said deliquifying member.

25 23. The thickener/clarifier of claim 21 wherein said deliquifying member includes an opening adjacent its upper end for discharge of liquid into said free settling zone and said

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injector is positioned adjacent said opening in said
deliquifying member.